AN INTRODUCTION TO FOOD SAFETY ISSUES IN VIETNAM[1]

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Since the end of the 90s, Food safety has become a priority issue in Vietnam and may stay so for the coming decade.

I. The main reasons for the increase in concern over this public health issue are as follows:

• An increasing number of food poisoning cases are reported each year, which, according to the WHO are inaccurately low (2006).

1,831 outbreaks, 36,955 cases and 499 deaths were reported from 2000 to 2009 (Table 1). The number of food poisoning cases has not significantly decreased over the years, although food safety issues have been a high priority issue since 1999. The comparison between officially reported data and estimations of the real situation show a large discrepancy, revealing weaknesses in the food poisoning surveillance system. This is also revealed by the high number of reported diarrhoea cases (Table 3), almost 1 million cases every year. Recurrent cholera epidemics in Hanoi emphasize the need to address adequate hygiene control measures for water and food. From October 2007 to April 2008, there were 3 major outbreaks, with a total of 2,789 cases reported, of which 438 cases where V. cholerae could be isolated.

Table 1: Number of official reported food poisoning cases from 2000 to 2009

Year	Out-breaks	Cases	Deaths
2000	213	4 233	59
2001	245	3 901	63
2002	218	4 984	71
2003	238	6 428	37
2004	145	3 584	41
2005	144	4 304	53
2006	165	7 135	57
2007	247	7 329	55
2008	205	7 828	61
2009 (2 Months)	11	229	2
Total	1 831	49 955	499

Source: Vietnam Food Administration (VFA); http://www.vfa.gov.vn

The origin of officially reported food poisoning cases are mainly microbiological (33.2% on average), then bio-toxins (23.5%), chemical (9.6%), with the final 32.1% remaining of undetermined cause (Table 2). The high level of undetermined causes emphasizes the need for improving laboratory diagnostic capacities. The VFA does not give information about the bacteria responsible. However, in a study on infant diarrhoea cases in the Red River Delta, Campylobacter jejuni (26%), Campylobacter coli (5%), Shigella (30%), ETEC (29%), EIEC (5%), Salmonella (4%), and others (1%) were isolated (Isenbarger, et al., 2001).

Table 2: Origin of official reported food poisoning cases per year from 2000 to 2009

Origin (%)	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	Mean
Microbio-logical	32.8	38.4	42.2	49.2	56.5	51.4	38.8	6.1	7.8	9.1	33.2
Chemical	17.4	16.7	25.2	19.3	12.4	8.3	10.9	0.8	0.5	0.0	9.6
Bio-toxins	24.9	31.8	25.2	21.4	22.7	27.1	25.5	21.9	25.4	9.1	23.5
Undeter-mined	24.9	13.1	7.4	10.1	8.3	13.2	24.8	71.3	66.3	81.8	32.1

Source: Vietnam Food Administration (VFA); http://www.vfa.gov.vn

Inquiries in Hanoi and HCMC on 3,000 people found that 12% had at least one diarrhoea episode during the year. 21% of the diseased persons consulted a physician and 13% were hospitalized. Based on inquiries during outbreaks, diarrhoeal cases per year were estimated to be up to 128 million per year, of which 27 million required medical treatment and 3.5 million necessitating hospitalization (Kim, et al., 2004). This estimate shows that the cases reported by the Ministry of Health (Table 3) based on reports from physicians in medical dispensaries and hospitals may be inaccurately low. Not only does death and illness result, but also this diarrhoeal situation in Vietnam creates a huge economic burden for the country.

In many cases, the origin of the reported food poisoning outbreaks remains undetermined. Plainly, there is an urgent need for a laboratory network comprising approved reference laboratories staffed by trained professionals to diagnose specific food hazards. Public health stakeholders, (medical, veterinarian public health, researchers, education and training, food processing industry, breeders, markets, consumers, etc.) must coordinate their efforts while avoiding overlapping efforts between the above-mentioned sectors.

Table 3: Number of official reported diarrhoea cases from 2000 to 2007

Year	Cases	Deaths
2000	984 617	19
2001	1 093 864	21
2002	1 062 440	14
2003	972 463	10
2004	894 800	17
2005	898 753	10
2006	992 137	15
2007	974 586	24
Total	7 873 660	130

Source: Vietnam Food Administration (VFA); http://www.vfa.gov.vn

• Widespread hazards in the food and environment:

New food safety issues are reported each week in the country's media: from hormone residues in pork -mainly Clenbuterol used in animal feed- , to borax and additives in delicatessen products, antibiotic and melanin residues in milk , heavy metals in drinking water, pseudomonas aeruginosa in bottled water , the list goes on... As an illustration of the widespread presence of residues and their deleterious effect on health, one study proved that persistent organochlorines (PCs) were present in human breast milk in Hanoi and Hochiminh city, and these products could already be associated with some diseases found in newborns, like congenital cryptorchidism, for example (Brucker-Davis, et al., 2008; Minh, et al., 2004). Several studies showed that OCs and PCBs are widespread in the Red River Delta. They were also found

in surface water (Hung and Thiemann, 2002), sediment (Phuong, et al., 1998), fish, molluscs and both migratory and domestic birds (Minh, et al., 2002). A broad range of OCs have also been isolated in various foodstuffs: "Elevated levels of PCBs, DDTs, HCHs, and aldrin and dieldrin were found in animal fat, butter, meat, and seafood […]. Fish, shellfish, prawn, and crab were the primary route of DDTs to humans, whereas cereals and vegetables were the predominant sources of PCBs and HCHs" (Kannan, et al., 1992).

Bacteria such as Salmonella, Listeria, Campylobacter, Yersinia, S. Aureus, etc, are commonly isolated in animal production chains and can become a threat to human health when they reach consumers' plates, through uncooked products or cross-contamination. The emergence of antimicrobial resistant strains induces resistance to treatment and can lead to cross-resistance with other pathogens. Such is the case for Tuberculosis, which has become a life threatening issue for immuno-depressed patients, for instance, (Wells, et al., 2007). Changes in eating and production patterns from traditional methods to modern industrial production can lead to new and unusual contamination patterns. Some bacterial toxins can even resist heat treatments; such is the case with S. aureus toxin in UHT milk, for instance. It is necessary to study the epidemiology in pre- and post-harvest production adapted to the Vietnamese context in order to implement efficient control measures.

• Increasing consumer concern over food safety, particularly in light of the avian flu outbreak. One study showed that chicken was particularly at risk, notably while in the processing stage prior to consumption (Fournier, 2005).

For most Vietnamese consumers, there is a direct correlation between food and health (Figuié, 2004), and although the nutritional quality of food has improved, consumers have expressed concern about other measures of quality, sanitary quality in particular. The hazards considered most threatening are chemical contaminants: pesticides, residues, hormones, antibiotics, and food additives. One study in HCMC showed that 90% of consumers were aware of Borax's toxicity, but they were still buying products containing Borax, because the products were cheaper, had a better taste, were not considered as harmful if eaten in small quantities, or because they didn't know where to buy borax free food (Thanh, et al., 2005). Although microbiological risks are not often spontaneously mentioned, they emerged as a priority concern in closed questions' questionnaires. Consumers don't know how they can prevent their exposure to this kind of hazards (Luan, et al., 2006).

• In 2006, Vietnam was the 150th country to become a member of WTO .

The application of the SPS agreements requires a myriad of changes to the control and management of food hygiene and in the public health research sector. Articles 2.2 and 5.1 expressly mention that protection measures should be only based on scientific studies, following standard risk analysis procedures. Article 4.1 is related to the principle of equivalence, to which a country may refer to in cases where poor quality imported products place consumers at risk. Unfortunately, the equivalence principle, and thus the possibility of banning imports of potentially dangerous products can only be enforced if the importing country can prove the safety of its own production! The direct consequence of the article 4.1 is the obligation to implement efficient food hygiene research, control programmes and monitoring systems using reliable and transparent data. "Risk-based surveillance and inspection is still in its infancy and there is much to do before risk-based monitoring and inspection systems are fully implemented", reports a research work for the Standards and Trade Development Facility. Food safety also represents a limiting constraint for exports. Considering that a Vietnamese Governmental policy is to increase exports in the coming years: "The total losses to the Vietnamese economy from SPS problems surpass US$1 billion per year. Food-borne pathogens and high level of toxins in foodstuffs, plant pests and animal diseases (including highly pathogenic avian influenza or HPAI) are the main problems faced" .

II. Possible food hazards in the porcine production chain in the Vietnamese context

• In Vietnam, nontyphoidal Salmonella has been isolated from humans diagnosed with diarrhea (Isenbarger, et al., 2002; Vo, et al., 2006b) and cultured from various food products--particularly from pork processed in slaughterhouses (Dao and Yen, 2006; Murugkar, et al., 2005; Padungtod and Kaneene, 2006; Quang, 1999).

77% of meat consumed in the country is pork. Sample screening carried out on retail pork identified 33-40% Salmonella-positive samples (Dao and Yen, 2006; Thuy, et al., 2006b). In South Vietnam the prevalence of Salmonella in swine faeces, carcasses and meat was between 5.2-69.9% (Phan, et al., 2005; Vo, et al., 2006b). For other food pathogens, study examples are summarized in Table 4.

Currently in Vietnam, epidemiological studies on food borne pathogens along commodity channels and contamination data are scarce. This kind of research is needed in order to understand the means of contamination associated with practices at each level in the production chain. Understanding the epidemiology allows adaptation of the least expensive control measures adapted to the specific context.

• The Directive 07/2002/TTg from the Government of Vietnam provides a list of banned chemical, antibiotic and other veterinary drugs in livestock and aquaculture production. Nevertheless, due to lack of control drug sales, purchase and use, many illegal drugs are used at the production level, including growth hormones.

During processing, additives are commonly used to give a better colour or to allow a longer preservation of the meat. Most of these products are not possible to trace, as they may be sold without a label, under another label or under the distributor shop's name. Some of the substances used are sometimes reported in the media, warning the consumers about specific abuses . A study in Thai Nguyen province could detect food colouring agents in 12.1% of the samples. The most frequent isolated one was red colouring agent in meat, candies and jams (Thu, 2004).

Borax is frequently used in delicatessen products like "gio", traditional cooked Vietnamese mortadella or "cha", minced and processed pork meat usually grilled and consumed as "bun cha", or "nem chua", minced raw pork meat naturally fermented in a banana leaves (Hanh, et al., 2003). In Ba Ria Vung Tau Province, 80% of the samples (n=166) were found positive for borax, in "bo vien" or "moc", minced beef or pork meat pellets consumed in traditional dishes like "pho", or in "cha chien", flavoured minced pork meat usually grilled on skewers (Ha and Linh, 2005). According to experts, 15% of ingested borax would remain in the body, mainly in the lever, brain, lungs, stomach, intestine and kidneys. The symptoms of borax intoxication are not specific: although nausea, vomiting, apathy and tiredness are common. In certain cases, however, a degeneration of sexual organs or embryo lesions by pregnant women has been observed.

• Antibiotic use in livestock production can lead to two main public health issues:

1- Antibiotic residues in meat can have a direct impact on consumers, such as allergies or resistance to antibiotic treatments of for disease, 2- The risk of antimicrobial resistance's transmission from animal to human pathogens (Le Bas, 2003). Although a major part of the resistance of human pathogens is attributed to the use of antibiotic treatments by humans, the scientific community has admitted that the emergence of resistant bacterial strains is partly due to the intensive use of antimicrobial drugs in livestock production.

In Vietnam, the increase of bacterial resistance to antimicrobials used to treat livestock has already been demonstrated by various data. In South Vietnam, for example, 40% of Salmonella strains isolated (n=297) from various origins were multi-resistant (Vo, et al., 2006a). Another study found 100% of Escherichia coli and 82% of

Salmonella strains resistant to tetracyclines (Hảo, et al., 2004). In Dak Lak, the proportion of resistant Salmonella strains from 1993 to 2003 increased (Chuong, 2005). Finally, 89,5% of E. coli and 78,6% Shigella strains isolated in children with diarrhoea were multi-resistant (Nguyen, et al., 2005).

According to the World Bank, quantitative data about antibiotics' use in Vietnam are still lacking, especially in the meat and fish production chains (2006).

Table 4: Potential hazards associated with pork meat consumption with examples of research in Vietnam.

Type of hazard	Examples	Reference/comments
CHEMICAL		
Residues		
Antibiotics	Chloramphenicol, Quinolones, tetracyclines	(Hanh, 2004; Isenbarger, et al., 2002; Vo, et al., 2006b)
Anabolic steroid	Clenbuterol	Big concern for urban consumers (Ginhoux, 2001)
Contaminants		
Pesticides	Carbaryl, DDT, Lindane	(Trang, et al., 2001)
Heavy metals	PB, Hg, Cd	(Trang, et al., 2001; Tu, 2006)
Dioxins	Agent Orange	
MICROBIOLOGICAL		(Blaha, 1997; Nielsen and Wegener, 1997)
Bacteria		(Ly, 2005; Quang, 1999)
Salmonella spp.	S. Typhimurium, S. Derby	(Le Bas, et al., 2006a; Le Bas, et al., 2006b; Le Bas, et al., 2006c; Phan, et al., 2004; Thuy, et al., 2002; Vo, et al., 2006b)
Campylobacter	C. jejuni, C. coli	(Dao and Yen, 2006)
Listeria monocytogenes		
Yersinia	Y. enterocolitica	
Bacillus	Bacillus cereus	(Thuy, et al., 2006a)
Staphylococcus	Stahylocossus aureus	(Thuy, et al., 2006a)
Clostridium	C. perfringens	(Thuy, et al., 2006a)
E. coli	EHEC, EIEC, VTEC	(Dao and Yen, 2006; Nghi and Nhat, 2005)
Leptospira	L. icterohaemorrhagiae	(Boqvist, 2002; Boqvist, et al., 2003)
PARASITIC		(Gamble, 1997)
Trichinellosis	Trichinella spiralis	(Roy, et al., 2001)
Cysticercosis	Cysticercus cellulosae (Taenia solium)	(Roman, et al., 2000; Somers, et al., 2006; Willingham, et al., 2003)
Ascaridiosis	Ascaris suum	Especially in pork/fish integrated breeding farms in South-Vietnam (De, et al., 2003; Hung, et al., ; Verle, et al., 2003; Yoshihara, et al., 1999)
Toxoplasmosis	Toxoplasma gondii	(Fan, et al., 2004)
Cyclosporosis	Cyclospora cayetanensis	(Lahrer, 1997)
FONGICAL		
Mycotoxines	Aspergillus flavus	Contamination through animal feed (mais, groundnut pellets) (Phung, 2002)

III. Action plans underway, and recommendations for improving food safety in Vietnam

• The Vietnam Food Administration (VF3A), Ministry of Health, was created in 1999.

A communication program on food safety issues has been implemented by the Government, involving Ministries and consumers and producers' associations. The Department of Communication, Education and Extension on Food Hygiene has been created to better sensitize consumers towards food safety issues. In Provinces and districts, Preventive Health Dispensaries undertake this responsibility (2006).

The prime minister has signed a decision adopting a National Food Safety Program for the period spanning 2006-2010. Accordingly, the program will be launched with a total capital of 1,300 billion VND. It has been approved by the Prime Minister's Decision Nr. 43/2006/QD-TTg: This directive seeks to: i) raise awareness and responsibility of food producers, dealers and consumers towards food safety and hygiene; ii) attempt to comply with world food standards; in order to achieve a targeted 100% of high-risk food production enterprises applying Hazard analysis and critical control point (HACCP); and iii) preventing the spread of food poisoning and diseases; etc. through food.

• The Main food hygiene regulations were set-up under the Prime Minister's Directive 08/1999/CT - TTg concerning strengthening quality assurance and food safety.

The Decision Nr. 14/1999/QD-TTg from the 2nd April 1999 created the VFA, and the Ordinance from July 2003 provided the framework for the main laws on food production .

• In order to become more competitive on the market and to avoid massive importations of lower quality products from abroad, Vietnam is in the process of setting up its own "good agriculture practices": VietGap. These standards are based on EurepGap and AseanGap .

• Food safety has also become a priority for international funding and development agencies.

The Vietnam Livestock Competitiveness and Food Safety Project funded by the World Bank, aims to strengthen the capacity of public and private agriculture sector institutions to enhance the competitiveness of food-supply chains and the ability of farmers and processors to respond to market demand for higher quality and safer products. The Food and Agriculture Products Quality Project implemented by the Canadian International Development Agency, seeks to improve practices in both food production and processing, product quality control and certification. This program includes the establishment of analytical laboratory capacity. The APEC food safety coordination forum, established in 2007, implemented a plan for strengthening food safety standards practices in APEC economies for 2008-2011 . The Danish-funded Fisheries Sector Programme (FSPS II), supports the further development of Vietnam's institutional framework, technical regulations and guidelines to improve traceability and food safety of fish and fish products . Technical Assistance from the Asian development Bank for implementing a "Project on Quality and Safety Improvement of Agricultural Products in Vietnam", in order to (i) promote production and processing of high value products; (ii) improve agricultural research, extension, and market information services; (iii) intensify efforts to ensure better product quality and food safety based on sound agricultural practices; and (iv) promote agribusiness and agro-based enterprises , etc.

• In line with the above mentioned plans and projects to improve food safety in Vietnam, priority actions should be taken to:

» Strengthen the capacity to implement the control and surveillance systems

» Promote coordination between the authorities responsible for food safety. This should include setting-up a laboratory network with reference laboratories, for both medical and veterinary public health, allowing the pool of data from human patients, food samples and at the pre-harvest stage

» Increase support to food processing and slaughtering plants, especially during the transition period to modernization: Focused good hygiene practices, based on improving facilities, training and controls, should be implemented in small plants which cannot afford HACCP procedures

» Promote quality-labels and safe production by supporting producers and farmers, in order to meet consumers' demand, improve farmers' income and avoid the concurrence of lower quality imported products

» Promote research: public health, zoonotic diseases, epidemiology, risk analysis, processing technologies and traditional recipes, environmental issues, macro- and micro-economy, sociology, etc. -- on a more long-term basis to identify the most suitable solutions in the Vietnamese context of intensifying and modernizing agricultural production.

IV. Links list to websites related to food safety in Vietnam

Title	*Links*
Vietnam Food Administration	*http://vfa.gov.vn/english/*
Veterinary Services – Department of Animal Health	*http://www.cucthuy.gov.vn/index.php?lang=en*
NIHE – national Institute of Hygiene and Epidemiology (Vietnamese)	*http://www.nihe.org.vn/IndexE.asp*
NIAH – national Institute of Animal Husbandry	*http://www.vcn.vnn.vn/*
HAU – Hanoi Agriculture University	*http://www.hua.edu.vn/en/*
HUT – Hanoi University of Technology	*http://www.hut.edu.vn/*
IPSARD - Institute of Policy and Strategies for Agriculture and Rural Department	*http://www.ipsard.gov.vn/news/defaultE.asp*
Database of Vietnam laws	*http://www.vietnamlaws.com*
Search for Vietnamese legal documents	*http://www.nea.gov.vn/luat/luat_eng/search.aspx*
Food and Agriculture Organization: Agricultural Sector in Vietnam	*http://www.fao.org/countryprofiles/index.asp?lang=en&iso3=VNM&subj=4&paia=*
Food and Agriculture Organization:	
Food Safety and Quality	*http://www.fao.org/ag/agn/*
World Health Organization:	
Food safety	*http://www.who.int/foodsafety/en/*
World Health Organization:	
Vietnam	*http://www.who.int/countries/vnm/en/*
World Bank: Vietnam	*http://web.worldbank.org/WBSITE/EXTERNAL/COUNTRIES/EASTASIAPACIFICEXT/VIETNAMEXTN/0,,contentMDK:21722081~pagePK:141137~piPK:141127~theSitePK:387565,00.html*
AFD in Vietnam	*http://www.afd.fr/jahia/Jahia/op/preview/lang/en/home/Qui-Sommes-Nous/Filiales-et-reseau/reseau/Portail-Vietnam/pid/850*
ADB in Vietnam	*http://www.adb.org/VietNam/default.asp*
PRISE – Research Consortium on Risks Associated with Livestock Intensification	*http://www.prise-pcp.org/en/*
MALICA- Markets and agriculture linkages for cities in Asia	*http://www.malica-asia.org/index.html*

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SALMONELLA ENTERICA SUBSP. ENTERICA ALONG THE PIG COMMODITY CHAIN IN VIETNAM

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ABSTRACT

Foodborne diseases are a particularly important concern in the current Vietnamese context, shortly after accession to the WTO, not only for public health reasons, but also because of the global evolution of consumer demand and habits, the production chain and state regulations. Salmonella enterica subsp. enterica (Salmonella) is known as one of the most frequent foodborne zoonoses in the world and has been isolated in human and pork products in Vietnam, where pork represents 77% of total meat consumption.

The aim of this paper is to describe Salmonella prevalence and epidemiology results along the pig commodity chain, at farm, slaughterhouses (both in Hanoi suburb, 206 samples and in slaughter plants connected with Nam Sach farmers in Hai Duong Province, 126 samples,) and for traditional raw meat fermented Vietnamese sausages 'nem chua'. The prevalences by fattening pigs at farm (19%) and in caecal content before slaughter (52% and 40%) were comparable to other studies, whereas the carcass contamination rates were much higher (95.7% and 67%). 35.7 % of 213 'nem chua' samples were positive. Serotyping of these isolates suggested that Salmonella contamination is mainly originated from the pig meat itself, with a smaller contribution from the sausages' processing steps. The results confirm that slaughterhouses in Vietnam are the key point to be focused on for improving food safety in the pork commodity chain. The potential public health threat of Salmonella in pork products has been proven by the high prevalence found on 'nem chua' sausages.

Further serotyping and genotyping of Hanoi slaughterhouses' isolates aimed to understand the ways of contamination of Salmonella at this important key step. The direct contamination of carcasses through faecal material from the same pig was not clear, but a direct faecal contamination was observed for the tank and the well water. Thus, our results suggested that the main source of carcass contamination was indirect, through the slaughtering environment. Moreover, the results may indicate that live pigs could be infected during lairage through contaminated water and environment, leading to a persistence of certain clones over longer periods.

Since the majority (about 90%) of the pig production in Vietnam goes through small slaughter plants, we propose priority economical hygienic control measures adapted to small plants, that could largely decrease the carcass contamination rate.

Keywords: Salmonella; epidemiology; pig;